It is logical, therefore, to endeavor to bring the immune serum in as high a concentration as possible into immediate relation with the seat of disease.

The power of the immune serum, when injected subdurally, to prevent the development of experimentally induced poliomyelitis in the monkey, is further indicated by experiments[9] in which, on the one hand, the virus has been injected into the blood under conditions insuring its escape into the meninges and, on the other, when an emulsion of the virus has been introduced directly into the meninges and followed later by the serum injection.

### SERUM THERAPY IN MAN

This aspect of the subject has been imperfectly developed up to the present time. Netter[10] was the first to apply the data obtained by experiments on monkeys to the treatment of cases of epidemic poliomyelitis in man. He has published the results obtained in a series of thirty-five cases which he regarded as highly favorable to the method. He employed the serum from cases of poliomyelitis in which complete recovery from the acute condition has taken place some time and even as long as thirty years previously. The serum injections were given subdurally as early after the appearance and recognition of the symptoms of poliomyelitis as possible. The dose of the serum, which must, of course, be sterile but need not be inactivated, should be determined by the age of the patient and will, in part, be determined by the quantity of serum available. Probably doses ranging from five to twenty cubic centimeters will be found suitable, the injection to be repeated once or more times at twenty-four hour intervals according to clinical conditions and indications. The effects of the immune serum should be sought in the checking of the progress of the disease, namely the prevention or minimization of the paralysis when employed in the preparalytic stages, and the arrest of its extension when used in progressing paralytic conditions. Since the immunity substances have been determined by neutralization tests to persist in the blood for many years, it is probable as Netter has indicated that persons who have passed through an attack of poliomyelitis several years earlier may be utilized as sources of the serum; while reasoning from analogy it would probably be advantageous to prefer persons whose attack was less remote so as to insure as high concentration of the immunity bodies as possible. The conditions surrounding the injection of the serum are identical with those observed in the analogous case of epidemic meningitis. Before each dose of serum is injected a suitable quantity of cerebro-spinal fluid is to be withdrawn, and the injection should be made slowly. In choosing the person who is to serve as the source of the blood from which the immune serum is to be derived precaution should of course be taken to secure a healthy donor; it would be advisable to fortify the usual clinical examination by a Wassermann test.

SIMON FLEXNER

[9] Flexner, S., and Amos, H. L., "Localization of the Virus and Pathogenesis of Epidemic Poliomyelitis," *Jour. Exper. Med.*, 1914, XX., 249.

[10] Netter, A., "Serotherapie de la poliomyelite nos resultants chez trentedeux malades," Indications technique—incidents possibles, *Bull. de l'Acad. de Med.*, Oct. 12, 1915. Netter, A., and Salanier, M., "Deux nouveaux cas de poliomyelite a debut meninge gueris par les injections intrarachidiennes de serum d' anciens malades," *Bull. Mem. Soc. Med. des Hop. de Paris*, Mar. 10, 1916.

## THE CULTURE VALUE OF SCIENCE[1]

WISHING not to squander any of the few minutes allowed me in this program, I have written down what I have to say, and hope you will pardon me if by reading I seem unduly formal for the occasion.

The Scripps Institution for Biological Research believes it has a mission over and above what is indicated by its name. As "nominated in the bond," its function is to produce new knowledge in the realms of nature with

[1] Remarks to the teachers of science in the secondary schools of southern California on the occasion of their visit to La Jolla and the Scripps Institution for Biological Research of the University of California during the teachers' institute week in November, 1915.

which it is occupied. But it would do something also toward the humanization of science. Its work is not only to *make* science, but to make science *human*. Concerning its science-producing function you will learn something to-day from the other members of the staff. So the time at my disposal may be devoted to saying a little about what we mean by humanizing science.

First, I remark on the eagerness with which we avail ourselves of this opportunity to help you, teachers of science in the secondary schools, to become acquainted with the institution. We know well enough that if ever our theories about the humanization of science are to be realized, the teachers of boys and girls must be a large, probably the largest, factor in doing it.

Despite the stupendous development of physical science in our day, there is wide-reaching, deep-seated misconception as to what science is; and this misconception is not confined to the laity. It pervades the fold of science itself. This assertion may surprise you; but I believe a little reflection will convince you of its truth. Being teachers, you do not need to be told that the curricula of practically all schools make the sharpest distinction, expressly or tacitly, between humanistic subjects and scientific subjects; between cultural and practical studies, science being the backbone of most of the practical courses. Have you ever known or heard of a school that considered its science courses to be cultural in a genuine sense? When "culture courses" are spoken of, are the scientific ones ever referred to? If so, it is only in the few instances where some science teacher of exceptional insight and personal force has driven his or her colleagues to accept such a valuation of subjects. So far as my observation has gone, admission of the culture-value of science that is not half-hearted and grudging is so rare as to be practically negligible. And a fact of grave concern is the tendency vocational training has to blindfold scientists and teachers of science into accepting this exclusively physical valuation of science. From this influence and others it happens that science has become the ally, and to a large extent the background, of that theory and practise in the civilization of our day variously spoken of as economism, industrialism, and commercialism. The monstrous power this theory of civilization has for destroying all that is finest and noblest and most cherished in human life is at last being recognized by certain thoughtful persons. But few there are, apparently, who yet see with clear vision the profound importance for the situation of beliefs touching the cultural value of science. One lot of philosophers take the ground that on the whole science is proving itself an enemy to mankind. They say the undeniable good science has done in providing man with more and better things to eat and wear, better dwellings, better means of communication, more abundant material wealth, greater immunity from disease, and so forth, are insufficient to offset the harm it does in robbing him of aspirations, ideals, faiths, sensitiveness to beauty in nature and in art, and love of his fellow beings. Just how numerous and influential these philosophers are, is difficult to estimate; but without doubt a sentiment of this kind is widespread in the community. It seems to have been growing during the last few decades; and the three-continent-wide struggle now raging is unquestionably helping it on. The dreadnaught service, the submarine service, the air-machine service, the giant artillery service, the poisonous-gas service, and the rest, are making evident to the whole world how efficient the several departments of Hell can be made by making them thoroughly scientific. "Poor science," said a writer for a Socialist paper the other day, "is too busy working in the service of militarism, perfecting instruments of destruction," to do much toward the advancement of civilization. I am sure science is less honored, less prized to-day, for any purpose not commercial or purely physical in some way, than it was when I was young; and to one aspect of the matter I would direct your special attention.

Beyond a doubt these later years have witnessed a flocking of people in increasing numbers to occult and mystical doctrines and practises of various sorts. Make the rounds of the bookshops in almost any city and you will find

writings of this character more numerously and conspicuously displayed than works on scientific subjects other than those of applied science and school text-books. Judging from the testimony of publishers and book-dealers, the public is finding little in modern science that satisfies the deepest needs of human life. I want to insist that a radical change will have to be wrought in the feeling of educated people generally toward science, if civilization is to rise much above its present level.

But estimation of the worth of science can be changed only as an incident to a profound change of conception of and feeling for nature. Let no one, especially no teacher of science, fail to make the sharpest distinction between *nature* and *science*—between nature itself and knowledge of nature!

I just mentioned *feeling* for nature. Here, I am persuaded, is the key to the situation. I wonder to what extent you have noted that the scientific authorities you read and meet rarely love nature. If they do, they rarely say so, or reveal their feeling in any way. In fact, it would be surprising if you have not been admonished by your leaders that *feeling* must be frozen out of science. With many a scientist the stigma that attaches to the phrase "nature lovers," from having been applied to a group of slop-overs has been extended to everybody who manifests love for nature in any way.

We touch a subject here too vast to do much with in a talk like this. I can only remark that practical experience and the psychology of feeling demonstrate the utter fallacy of the theory that science must be emotionless. Have you yourself or has anybody you ever saw or heard of, done thoroughly well any task into which the "whole heart," as we say, has not entered? But the "whole heart" is, as modern psychology is making us understand, the unerring folkway of saying that the feelings, the affective side of our natures, though not the intellect, must be ever present along with intellect in all high and effective endeavor. And I urge you to mark well this fact: The very men of science who depreciate love of nature do not hesitate to extol love of truth. Truth, they say, not only may be, but must be loved that its pursuit, even by science, shall be assured. We hear men preach love of truth and of emotionless science, almost in the same breath!

But what is truth? The query has beset all the sages of all the ages. Curiously enough, when you come to reflect, the sages who have sweated blood over this question have not been students of nature at all as modern science understands the phrase. The sages have looked at a few aspects of nature and have speculated endlessly and earnestly about nature; but they have not studied it.

Let a humble naturalist try his hand at defining truth. *Truth* (with as big a *T* as you please) *is all that has been learned plus all that remains to be learned about nature.* At the particular institution of scientific research which you visit to-day, the theory is held that nature and truth, while not identical, yet have so much in common—overlap each other in so much of their range—that whatever place *feeling* rightly has in the pursuit of the one, it has in the pursuit of the other. And here is the most vital spot of all: Men love truth because truth is to their advantage. It is beneficent—it makes goodness in their lives. Exactly so with nature according to our theory. Nature is beneficent. It is a maker of goodness in human lives. Indeed, excepting through nature, there is no goodness; and the chief end of science is to show in detail and literally how we live, move and have our being in nature. Through the achievements of modern medicine and hygiene and agriculture and industrial chemistry and mechanics, the most enlightened persons seem to have become convinced at last that nature is man's preserver and sustainer. It remains now for them to become convinced that nature is man's maker as well as his sustainer. This task falls more heavily on biology than on any other science.

So I ask that while you look over the "plant" of the Scripps Institution to-day and while you work toward a decision on whether or not you can accept the invitation we hope to extend to you before long to spend a little time at the institution next summer on some

work with us, you keep constantly before you the ideas and ideals of the institution here so sketchily described.

Wm. E. Ritter

La Jolla, Calif.

## THE NATIONAL RESEARCH COUNCIL

On April 19, 1916, at the closing session of the annual meeting, the National Academy of Sciences voted unanimously to offer its services to the president of the United States in the interest of national preparedness. The council of the academy was authorized to execute the work in the event of the president's acceptance.

On April 26 the president of the academy, accompanied by Messrs. Conklin, Hale, Walcott and Woodward, was received at the White House by the president of the United States. In presenting the resolution adopted at the annual meeting, it was suggested that the academy might advantageously organize the scientific resources of educational and research institutions in the interest of national security and welfare. The president accepted this offer, and requested the academy to proceed at once to carry it into effect.

Immediately following this visit, the president of the academy, in harmony with resolutions adopted by the council on April 19, appointed the following organizing committee: Messrs. Edwin G. Conklin, Simon Flexner, Robert A. Millikan, Arthur A. Noyes and George E. Hale (*chairman*).

At a meeting of the council of the academy, held in New York on June 19, the organizing committee presented the following statement of work accomplished up to that date.

Much time was devoted during the first five weeks to the organization of committees to meet immediate needs, including those on Nitric Acid Supply (A. A. Noyes, chairman), in cooperation with the American Chemical Society; Preventive Medicine (Simon Flexner, chairman), in cooperation with the Committee of Physicians and Surgeons, and Synthetic Organic Chemistry (M. T. Bogert, chairman), in cooperation with the American Chemical Society. Special attention was also given to arrangements for cooperation with the scientific bureaus of the government, the committee of physicians and surgeons, the naval consulting board, the national societies devoted to branches of science in which committees were immediately needed, the national engineering societies, the larger research foundations, certain universities and schools of technology, and the leading investigators in many fields of research, both on the industrial and the educational side. The hearty encouragement received from all of these men and institutions leaves no doubt that, as soon as a general request for cooperation is sent out, it will meet with universal acceptance.

During this preliminary period a more comprehensive plan of organization was developed, and finally embodied in the form indicated below. It was recognized from the outset that the activities of the committee should not be confined to the promotion of researches bearing directly upon military problems, but that true preparedness would best result from the encouragement of every form of investigation, whether for military and industrial application, or for the advancement of knowledge without regard to its immediate practical bearing. The scheme of organization must be broad enough to secure the cooperation of all important agencies in accomplishing this result.

After considering a variety of plans the organizing committee presented to the Council of the Academy the following recommendations:

That there be formed a National Research Council, whose purpose shall be to bring into cooperation existing governmental, educational, industrial and other research organizations with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defense, and such other applications of science as will promote the national security and welfare.

That the council be composed of leading American investigators and engineers, representing the Army, Navy, Smithsonian Institution and various scientific bureaus of the government; educational